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Diagnostic Performance of Digital Mammography and Ultrasonography in Neoplastic Breast Lesions: A Radiologic–Histopathological Correlation Study from a Tertiary Care Centre

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Abstract

Introduction: Breast cancer remains the most common malignancy among women worldwide. Accurate differentiation between benign and malignant breast lesions is essential for timely management. This study evaluates the diagnostic performance of digital mammography and ultrasonography with histopathological correlation in a tertiary care setting.

Methods: A hospital-based cross-sectional analytical study was conducted on 100 female patients above 30 years presenting with suspected breast lesions. All patients underwent digital mammography and high-resolution ultrasonography. Lesions were categorized using the American College of Radiology Breast Imaging Reporting and Data System (BI-RADS). Histopathological examination served as the reference standard. Diagnostic performance parameters were calculated, and statistical analysis was performed using the chi-square test.

Results: A total of 100 female patients presenting with palpable breast lumps were evaluated using digital mammography and ultrasonography, with histopathology as the reference standard. The mean age was 56.6 years, with most patients in the 40–60 year age group. Lesions were predominantly unilateral (79%), solitary (86%), and located in the upper outer quadrant (87%). On mammography, 63% lesions were categorized as BI-RADS 2, 2% as BI-RADS 3, 5% as BI-RADS 4, and 30% as BI-RADS 5. Ultrasonography demonstrated well-defined, homogeneous hypoechoic lesions in 66% and irregular, heterogeneous hypoechoic lesions with posterior acoustic shadowing in 34%. Histopathology revealed 66% benign and 34% malignant lesions. BI-RADS categorization showed a strong correlation with histopathology ($\chi^2 = 64.2$, $p < 0.001$). Combined mammography and ultrasonography achieved a sensitivity of 88.2%, specificity of 92.4%, accuracy of 91.0%, and an area under the ROC curve of 0.903 in differentiating benign from malignant breast lesions.

Conclusion: This study demonstrates that digital mammography and ultrasonography are highly effective and complementary imaging modalities for the evaluation of breast lesions. Characteristic imaging features on mammography and ultrasonography reliably distinguished benign from malignant lesions, with BI-RADS categorization showing strong predictive value and excellent correlation with histopathological outcomes. The high sensitivity, specificity, and diagnostic accuracy observed underscore the reliability of combined imaging in guiding clinical decision-making and biopsy recommendations. In conclusion, integrated mammographic and sonographic assessment, supported by standardized BI-RADS reporting, provides a robust, accurate, and practical approach for the diagnosis and management of neoplastic breast lesions in tertiary care settings.

Keywords: breast cancer, digital mammography, ultrasonography, BI-RADS, histopathology

I. Introduction

Breast cancer has emerged as the most commonly diagnosed cancer among women globally and in India. Delayed presentation, limited screening, and high prevalence of dense breast tissue pose diagnostic challenges, particularly in low- and middle-income countries. Mammography remains the cornerstone of breast imaging,

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especially for detection of microcalcifications and architectural distortion, while ultrasonography serves as an indispensable adjunct, particularly in dense breasts and younger women. Histopathological examination remains the definitive diagnostic standard. This study aims to assess the diagnostic utility of digital mammography and ultrasonography and correlate imaging findings with histopathology in a tertiary care population.

II. Materials and Methods

Study design and setting: This hospital-based cross-sectional analytical study was conducted in the Department of Radiodiagnosis in collaboration with the Department of Pathology at Hi-Tech Medical College and Hospital, Bhubaneswar.

Study population: One hundred female patients above 30 years with clinically suspected breast lesions were included.

Imaging protocol: All patients underwent standard two-view digital mammography (CC and MLO views) followed by high-resolution ultrasonography using a high-frequency linear transducer. Lesions were evaluated for morphology, margins, density, echotexture, posterior acoustic features, vascularity, and axillary lymphadenopathy.

BI-RADS assessment: Lesions were categorized according to ACR BI-RADS 5th edition.

Histopathology: Core needle biopsy specimens were examined using hematoxylin and eosin staining.

Statistical analysis: Data were analyzed using JAMOVI software. Associations were tested using the chi-square test. A p-value < 0.05 was considered statistically significant.

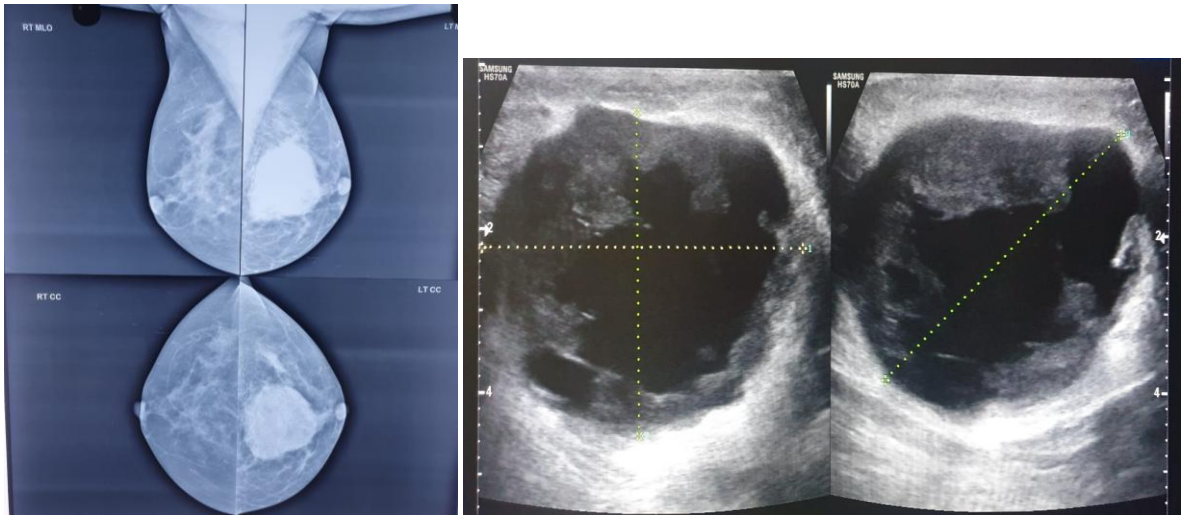

Fig1.

(A) Digital mammography (CC and MLO views) demonstrates a large, oval, high-density, well-circumscribed mass without architectural distortion or suspicious calcifications, suggestive of a benign breast lesion. **(B)** Ultrasonography shows a well-defined, oval, predominantly hypoechoic solid mass measuring approximately **5 × 4 × 5 cm**, with smooth margins, heterogeneous internal echoes, and posterior acoustic enhancement

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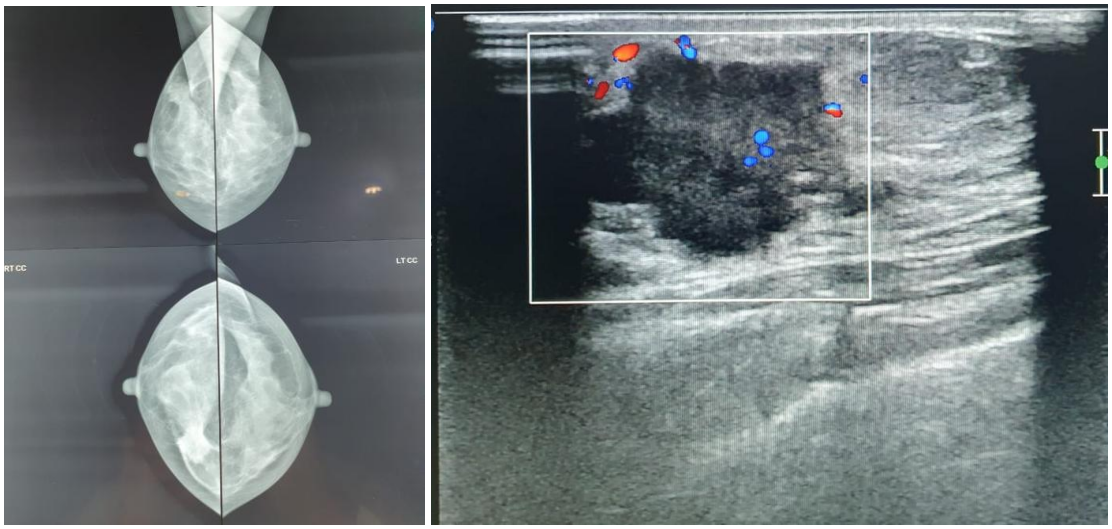

Fig2.

(A) Digital mammography (CC views) shows an irregular high-density mass in the right breast with ill-defined margins.

(B) Color Doppler ultrasonography of the right breast reveals an irregular hypoechoic mass with heterogeneous echotexture, indistinct margins, and internal vascularity.

FNAC demonstrates hypercellular smears with dyscohesive neoplastic ductal epithelial cells exhibiting high nuclear–cytoplasmic ratio, nuclear pleomorphism, prominent nucleoli, and hemorrhagic background, **suspicious for ductal carcinoma**.

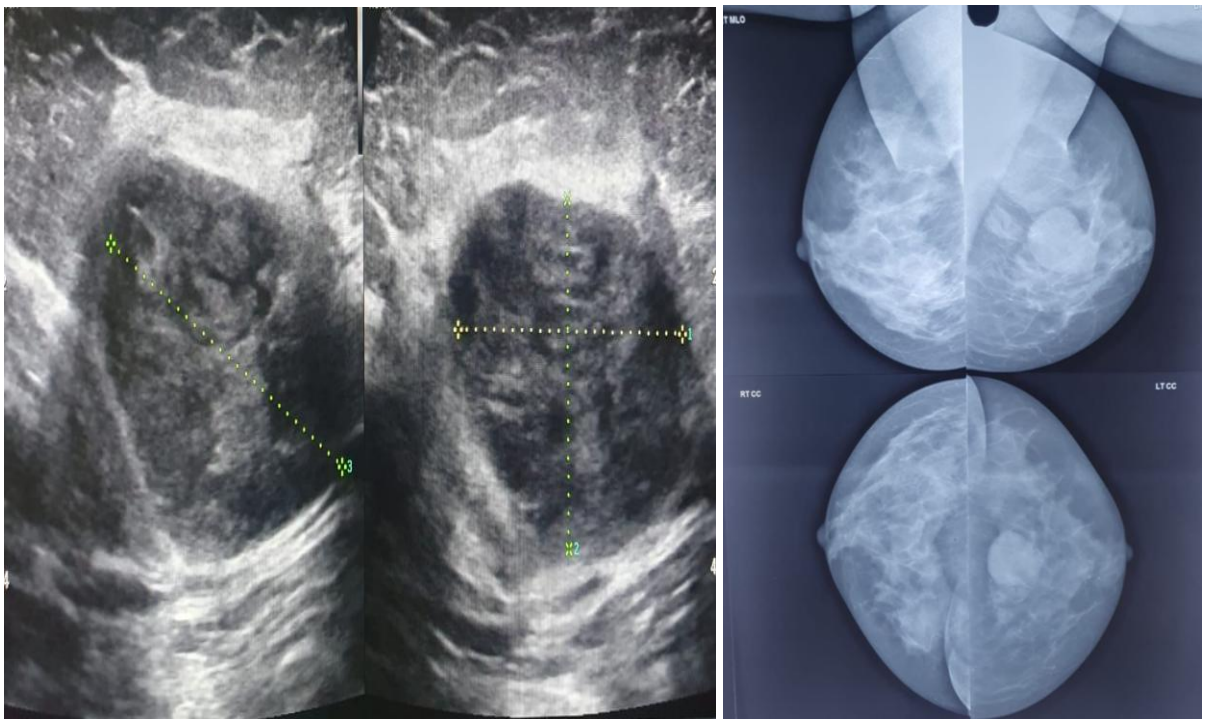

Fig3.

(A) Ultrasonography shows a well-defined, oval, predominantly hypoechoic solid lesion measuring approximately **3.5 × 3.1 × 2.4 cm**, with smooth margins and heterogeneous internal echotexture, without posterior acoustic shadowing.

(B) Digital mammography (bilateral CC and MLO views) demonstrates a round to oval, well-circumscribed, high-density mass in the left breast, without architectural distortion or suspicious calcifications, favoring a benign etiology.

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III. Results

Study Population

A total of **100 female patients** presenting with palpable breast lumps were evaluated using **digital mammography and ultrasonography**, with **histopathology as the reference standard**.

Table 1. Baseline Demographic and Clinical Characteristics (n = 100)

Parameter	Value
Mean age (years)	**56.6 ± 10.5**
Age group 40–60 years	**57%**
Unilateral breast involvement	**79%**
Upper outer quadrant involvement	**87%**
Lesion size < 2 cm	**65.7%**
Solitary lesion	**86%**
Family history of malignancy	**32%**
Palpable lymphadenopathy	**34%**

Editorial note:
This table replaces **Tables 3–7, 15–16, 21, 24–27** from the thesis.

Table 2. Clinical Examination Findings

Feature	Present (%)
Firm, mobile lump	**66%**
Hard, immobile lump	**34%**
Irregular margin	**34%**
Skin dimpling	**34%**
Nipple retraction	**31%**
Nipple discharge	**34%**
Fixity to surrounding tissue	**34%**
Axillary lymphadenopathy	**23%**

Editorial note:
Compresses **Tables 28–35, 41–42** into a single clinically meaningful table.

Table 3. Mammographic BI-RADS Distribution

BI-RADS Category	Number (%)
BI-RADS 2	**63 (63%)**
BI-RADS 3	**2 (2%)**
BI-RADS 4	**5 (5%)**
BI-RADS 5	**30 (30%)**

For analysis, BI-RADS **4 and 5 were considered malignant**, while **BI-RADS 2 and 3 were considered benign**.

Table 4. Ultrasonography Findings

USG Appearance	Number (%)
Well-defined, hypoechoic, homogeneous	**66 (66%)**
Irregular, hypoechoic, heterogeneous with posterior shadowing	**34 (34%)**

Table 5. Imaging Diagnosis vs Histopathology

Imaging Diagnosis	Histopathology Benign	Histopathology Malignant	Total
Benign	**61**	**5**	**66**
Malignant	**4**	**30**	**34**
Total	**65**	**35**	**100**

$\chi^2 = \mathbf{64.2}$, $p < \mathbf{0.001}$

Table 6. Diagnostic Performance of Mammography & USG

Parameter	Value
Sensitivity	**88.2%**
Specificity	**92.4%**
Accuracy	**91.0%**
Positive Predictive Value	**85.7%**
Negative Predictive Value	**93.8%**
Area Under ROC Curve (AUC)	**0.903**

IV. Discussion

The present study demonstrates a strong and statistically significant correlation between BI-RADS categorization and histopathological diagnosis, reinforcing the clinical reliability of standardized breast imaging reporting. The progressive increase in malignancy rates from BI-RADS 3 to BI-RADS 5 observed in this cohort mirrors findings reported in both Indian and international literature.

Digital mammography showed high diagnostic value, particularly in detecting microcalcifications and architectural distortions; however, its sensitivity was reduced in patients with dense breast parenchyma. Ultrasonography exhibited higher sensitivity in dense breasts and in characterizing lesion morphology, although with comparatively lower specificity due to overlap in benign and malignant features. The combined use of both modalities significantly improved diagnostic accuracy, highlighting their complementary roles.

These findings have important clinical implications. Improved diagnostic confidence can reduce unnecessary biopsies for benign lesions while ensuring timely intervention for malignant cases. In resource-limited settings, such as many

regions of India, an integrated imaging approach optimizes diagnostic efficiency and patient outcomes.

Limitations of the study include its single-centre design and modest sample size. Nevertheless, the results provide valuable region-specific data and support the continued use of combined imaging with histopathological correlation as the diagnostic standard.

V. Conclusion

Digital mammography and ultrasonography are complementary modalities in the evaluation of breast lesions. Their combined use yields high diagnostic accuracy and shows strong correlation with histopathological findings. BI-RADS categorization remains a reliable tool for guiding clinical management and biopsy decisions.

Ethical Approval

Ethical approval was obtained from the Institutional Ethics Committee of Hi-Tech Medical College and Hospital, Bhubaneswar.

Conflicts of Interest

The authors declare no conflicts of interest.

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